



ontario hydro research division

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Attn: Mr. E.G. Brookland

OTTAWA-HAWTHORNE TS T/R SURVEY

H.S. Radhakrishna

In situ and laboratory measurements of the soil thermal resistivity were made along the proposed underground cable route inside Hawthorne TS. The soil types encountered were silty sand and clayey silt. The ground water table was within one meter depth and the soils were generally wet. In situ thermal resistivity values ranged from 60°C cm/W to 80°C cm/W. Based on the statistical weather data analysis and neglecting the presence of the ground water table, the worst case thermal resistivity of 100°C cm/W is recommended to be used for the native soil in the ampacity calculations.

INTRODUCTION

A soil thermal resistivity survey was conducted for the proposed 115 kV double circuit U/G cable within the Ottawa-Hawthorne TS yard. The survey included:

1. In situ thermal resistivity measurements at 5 locations.
2. Collection of undisturbed soil samples at depths of 0.5 m, 1.0 m and 1.5 m for laboratory testing.
3. Laboratory measurement of thermal resistivity vs moisture content on undisturbed samples along with soil classification tests.

TEST RESULTS AND DISCUSSION

Soil sampling and in situ thermal resistivity measurements were made in test pits dug out by a backhoe to a depth of about one meter below grade. Table I summarizes the results of in situ thermal resistivity measurements and the data from the tests on undisturbed samples.

At the time of testing (May 1987), the ground water was encountered at a depth of one meter below grade and ground water was seeping into the test pits.

job	file	date	report no.
43-205-132	843.12	October 22, 1987	87-258-K

The soil moisture contents were generally high ranging from 20 to 30 per cent by dry weight. The soils encountered in Test Pits 1 and 4 were clayey silts while those encountered in Test Pits 2, 3 and 5 were silty sands (Figures 1 to 4).

In situ thermal resistivity values ranged from 60 to 80 °C cm/W. The results of stage drying tests shown in Figure 5, suggest that the soil moistures were at their field capacity or higher in May, 1987. The critical moisture levels at which a dramatic change in thermal resistivity occur is identified to be about 4 per cent for sandy soils and 8 per cent for clayey soils.

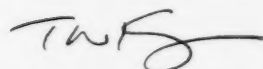
Using a 50 year weather data base, a statistical analysis of the variability of soil moisture and thermal resistivity was performed for the two soil types encountered. Results of the SWAP predictions are as follows:

<u>Soil Type</u>	<u>Maximum T/R °C cm/W for a Return Period of</u>	
	<u>30 years</u>	<u>50 years</u>
clayey silt	109	120
silty sand	89	102

CONCLUSIONS

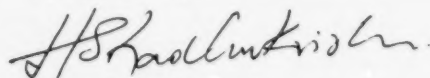
The soil types encountered within the TS yard area are clayey silts and silty sands. The ground water table is generally high at this station. A thermal resistivity value of 100 °C cm/W is recommended to be used in the design of cable backfill and the cable ampacity. The crushed limestone screenings that meets Ontario Hydro's specification should be used for cable thermal backfill.

Approved by:



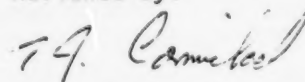
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TABLE I

Hawthorne In Situ T/R Testing in Test Pits

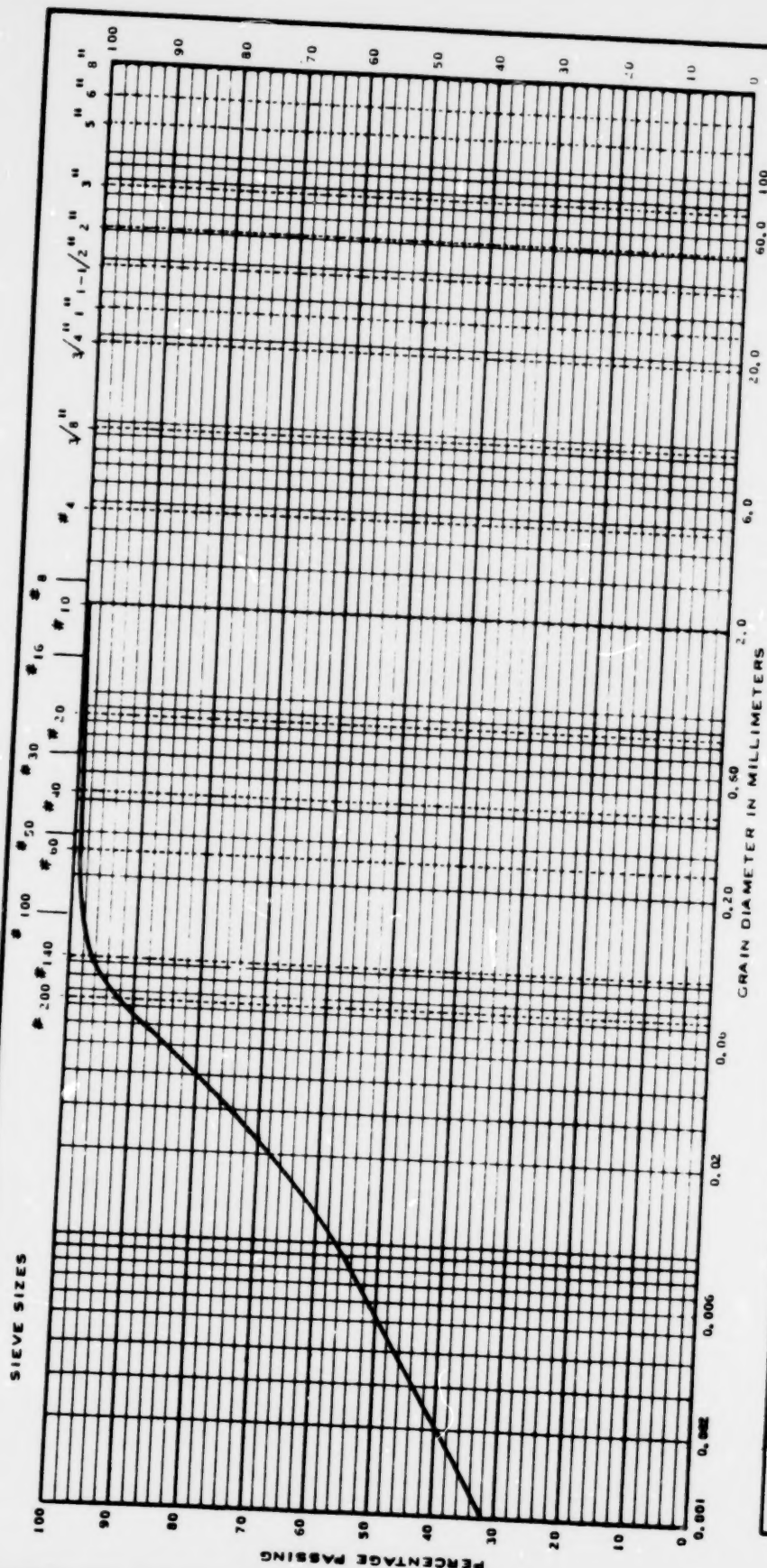
<u>Location Number</u>	<u>In Situ T/R °C cm/W</u>	<u>Comments</u>
1	63 °C cm/W G.W.L. = 0.95 m	- very wet, 3-4" of water in bottom of excavation - area where probe was inserted was dammed off
2	61 °C cm/W G.W.L. = 1.0 m	- test pit was fairly dry - a little free water evident just below excavation depth
3	64 °C cm/W G.W.L. = 1.0 m	- test pit fairly dry - some free water evident on bottom of excavation
4	61 °C cm/W G.W.L. = 0.45 m	- excavation fairly wet - water entering excavation from 0.45 m - test seemed fairly good
5	64 °C cm/W G.W.L. = 0.8 m	- excavation very wet - needed a sump pump to keep ahead of water and running sand - 1st test probe temperature dropped during test probably due to flowing ground water - 2nd test probe was inserted at a 45° angle into side of excavation in a little drier area

TABLE II

Hawthorne TS - U/G Cable Summary of In Situ and Laboratory T/R Results

Test Pit No	Depth (m)	Soil Description	% M/C	Dry Density (kg/m ³)	Thermal Resistivity °C cm/W	
					Field	Lab
1	1.19- 1.34	grey clayey silt with some sand	32.2	3758	63	78/82
1	1.19- 1.34	grey clayey silt with some sand				73/80
2	0.75- 0.90	grey sandy silt with a little clay	sample lost			71/74
2	1.09- 1.24	grey sandy silt with some clay	sample disturbed			65/69
3	1.19- 1.34	fine grey sand	24.5	4039	61	64/66
3	1.18- 1.33	fine grey silty sand	19.1	4032	66	62/65
4	1.26- 1.41	grey clayey silt with a little sand				70/71
4	1.30- 1.45	fine grey clayey silt with a little sand	20.6	4409	61	71/71
5	0.87-	fine grey silty sand	19.1	4409	60	54/55

MECHANICAL ANALYSIS



CLAY	TO SILT			SAND		GRAVEL		COBBLES
	FINE			MEDIUM		FINE	COARSE	

90992
new 80-11

FIGURE 1

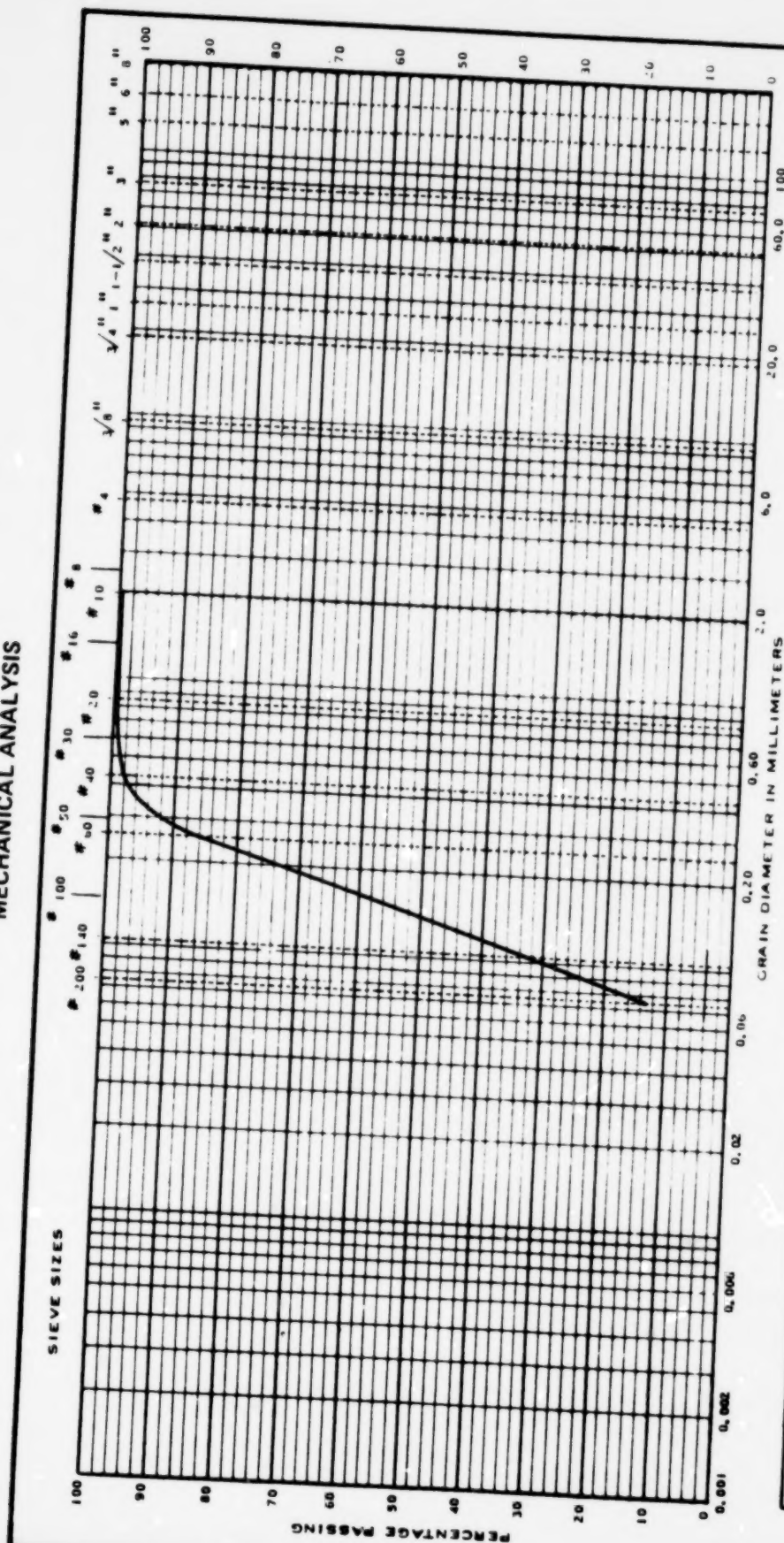
HAWTHORNE T.S.: - BH-1

DEPTH: 1.19 - 1.24m

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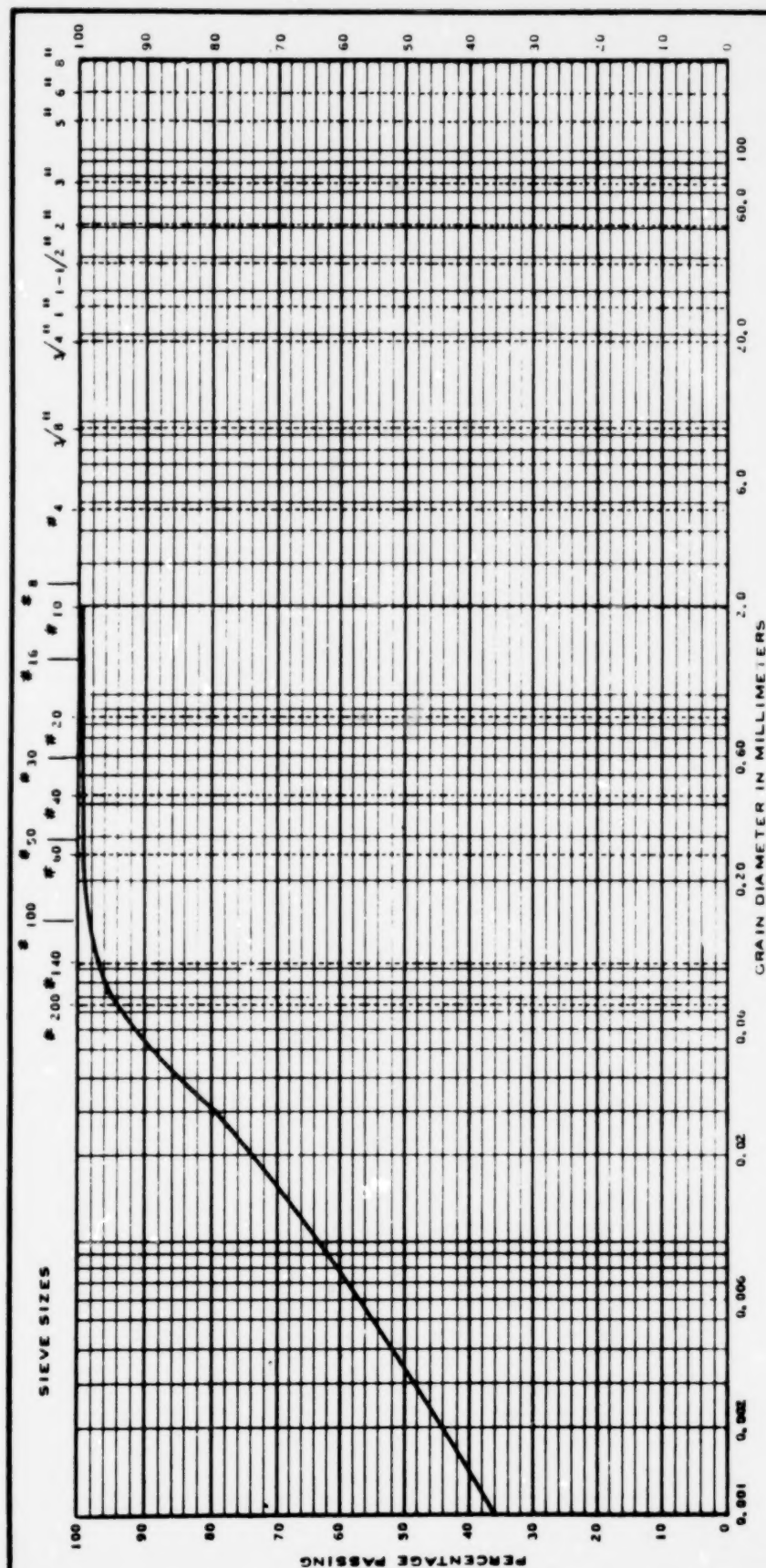
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MECHANICAL ANALYSIS



CLAY	TO SILT		FINE		SAND		GRAVEL		COBBLES	
UNIFIED SOIL CLASSIFICATION			COARSE	FINE	COARSE					
FIGURE 2 HAWTHORNE T.S.: - BH-3 DEPTH: 1.19 - 1.34m			90592 new 80.11		Ontario Hydro RESEARCH DIVISION					

MECHANICAL ANALYSIS



CLAY	TO SILT	FINE	SAND	GRAVEL	COBBLES

UNIFIED SOIL CLASSIFICATION



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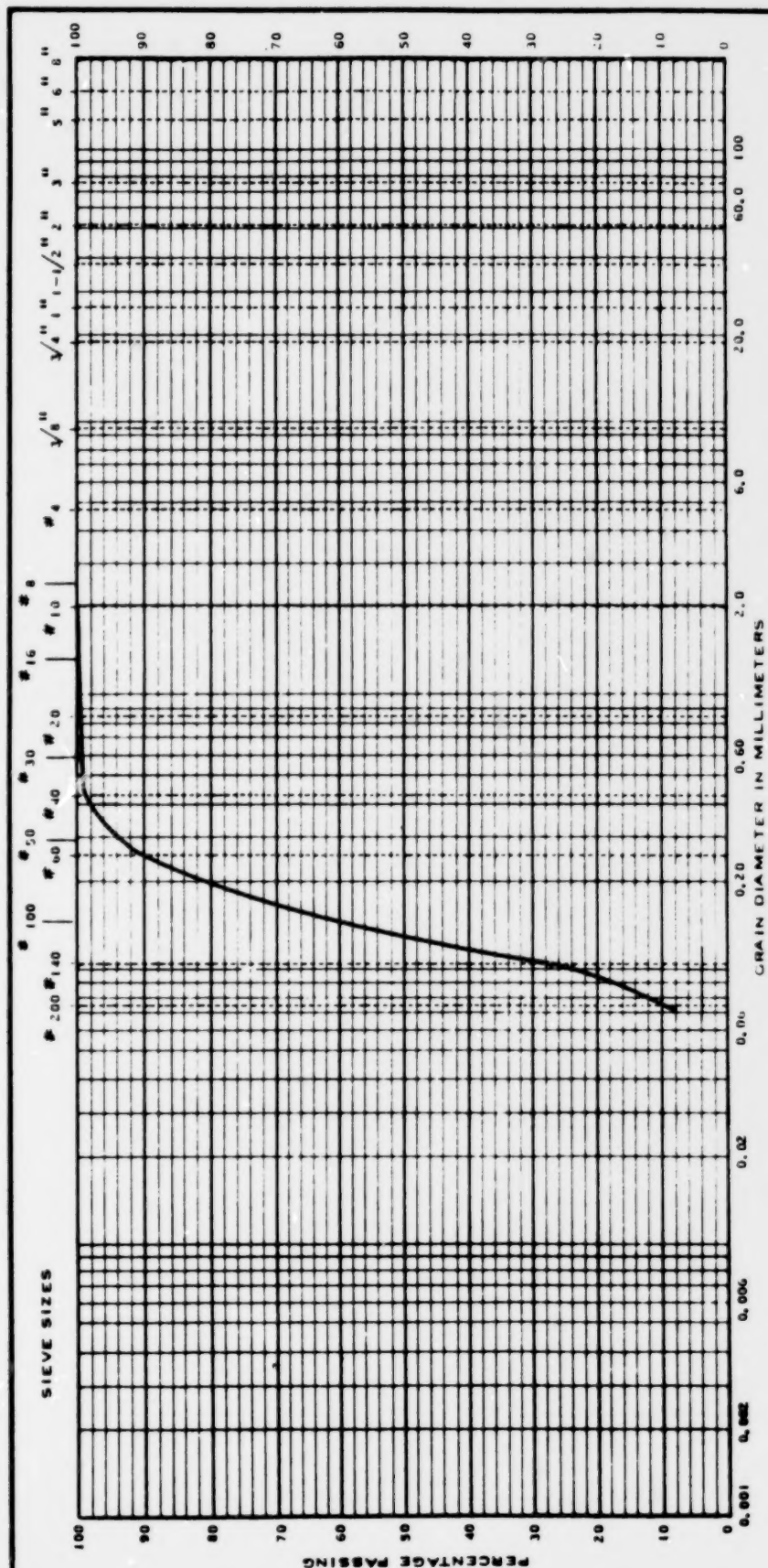
FIGURE 3

HAWTHORNE T.S.: - BH-4
DEPTH: 1.30 - 1.45m

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MECHANICAL ANALYSIS



CLAY		TO SILT		SAND		GRAVEL		COBBLES	
		FINE		MEDIUM		COARSE		FINE	
								COARSE	

90992
new 80-11



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FIGURE 4

HAWTHORNE T.S.: - BH-5

DEPTH: 0.87 - 1.02m

UNIFIED SOIL CLASSIFICATION

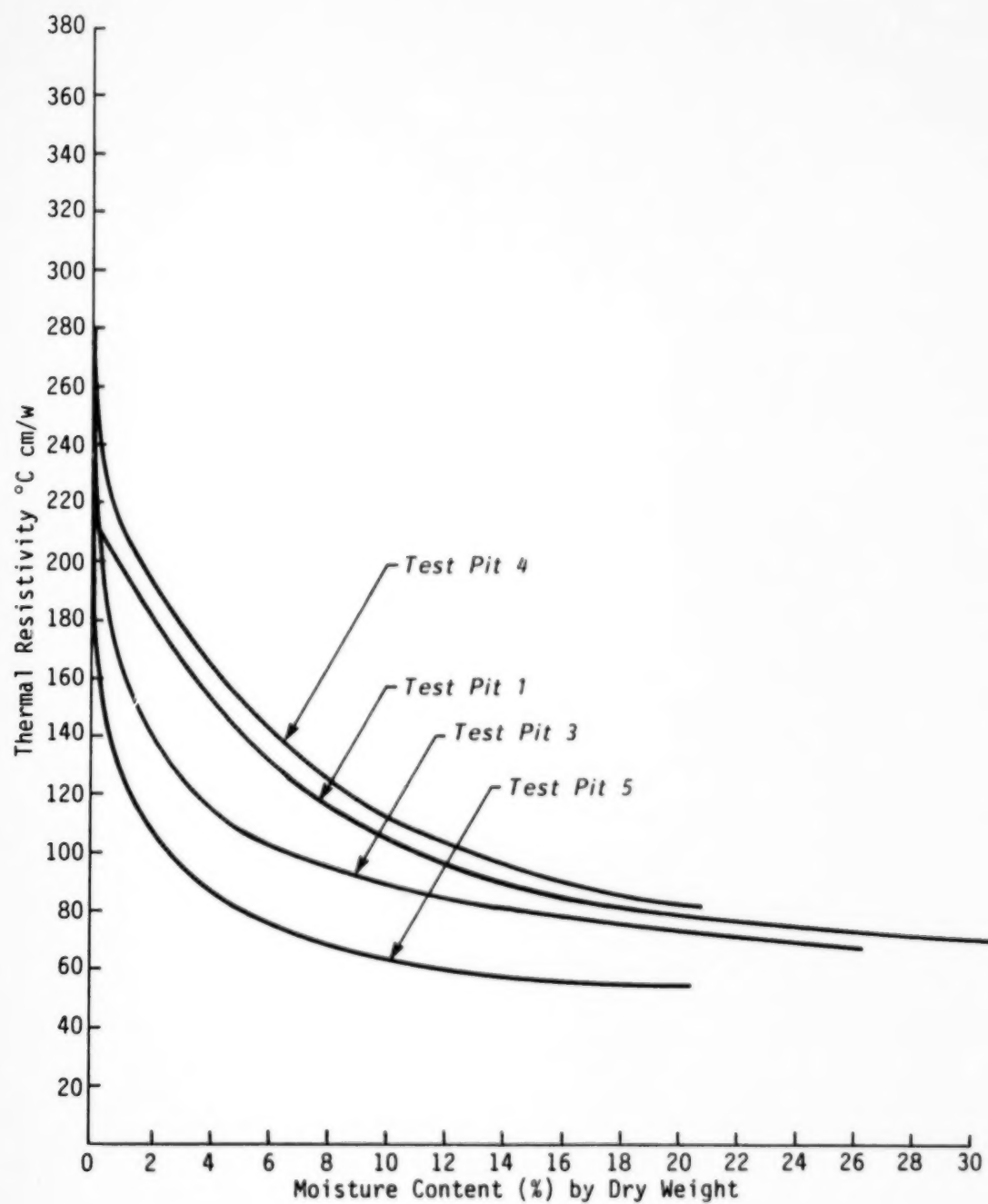


FIGURE 5
THERMAL RESISTIVITY VS MOISTURE CONTENT OF RESIDENT SOILS
HAWTHORNE T.S.

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